

U.S. Patent Application Serial No. 09/814,618
Reply to Office Action dated January 4, 2006

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Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously Presented) A three-dimensional image grabber, comprising:

a pattern projecting assembly for simultaneously projecting at least two phase-shifted patterns onto an object; each of said projected patterns being produced by decomposition of one of: a white light and: a non-white light including a plurality of monochromatic lights, into one of: a plurality of monochromatic lights and: non overlapping bandwidths; and

an image acquisition apparatus sensitive to said one of: said plurality of monochromatic lights and: said non-overlapping bandwidths for simultaneously taking an image of each of said projected patterns on the object.
2. (Previously Presented) The three-dimensional image grabber as recited in claim 1, wherein at least one of said at least two phase-shifted patterns is monochromatic.
3. (Previously Presented) The three-dimensional image grabber as recited in claim 1, wherein said pattern projection assembly includes a semi-transparent plate including a pattern to be illuminated by an illuminating assembly, a spectral splitter to be positioned between said semi-transparent plate and said illuminating assembly and a projector for projecting said semi-transparent plate onto said object; said illuminating assembly including a source of white light so positioned as to be projected through said semi-transparent plate.
4. (Previously Presented) The three-dimensional image grabber as recited in claim 3, wherein said illuminating assembly further includes an optical fiber and a condenser for bringing light from said white source to said semi-transparent plate.

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5. (Previously Presented) The three-dimensional image grabber as recited in claim 3, wherein said semi-transparent plate is a grid.
6. (Previously Presented) The three-dimensional image grabber as recited in claim 1, wherein said pattern projection assembly includes at least two pattern projecting apparatuses and a reflecting arrangement; each of said pattern projecting apparatus being configured to project a light having a predetermined bandwidth through a pattern; said reflecting arrangement being so configured as to direct said projected patterns along a common direction of incidence.
7. (Previously Presented) The three-dimensional image grabber as recited in claim 6, wherein at least one of said pattern projecting apparatuses includes a semi-transparent plate including a pattern to be illuminated by an illuminating assembly and a projector for projecting said plate onto said reflecting arrangement; said illuminating assembly including a source of light having a predetermined bandwidth and being so positioned as to be projected through said plate.
8. (Previously Presented) The three-dimensional image grabber as recited in claim 6, wherein said projecting arrangement includes at least one of a mirror and a semi-transparent mirror.
9. (Previously Presented) The three-dimensional image grabber as recited in claim 7, wherein said plate is a grid.
10. (Previously Presented) The three-dimensional image grabber as recited in claim 7, wherein said pattern projecting apparatuses are so positioned relative to each other as to each provide a same distance from said plate to the object.
11. (Previously Presented) The three-dimensional image grabber as recited in claim 1, wherein said image acquisition apparatus includes at least one camera sensitive to one of: said plurality of monochromatic lights and: said non-overlapping bandwidths.

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12. (Previously Presented) The three-dimensional image grabber as recited in claim 11, wherein said image acquisition apparatus includes a telecentric lens.
13. (Previously Presented) The three-dimensional image grabber as recited in claim 1, wherein said image acquisition apparatus includes at least two cameras, each sensitive to one of said plurality of monochromatic lights and: said non overlapping bandwidths.
14. (Previously amended) The three-dimensional image grabber as recited in claim 11, wherein said camera is selected from the group consisting of a Charge Coupled Device (CCD) camera and a Complementary Metal-Oxide-Silicon (CMOS) device.
15. (Cancelled)
16. (Currently Amended) A system for measuring the relief of an object, said system comprising:
- a pattern projecting assembly for simultaneously projecting at least three phase-shifted patterns onto the object; each of said projected patterns being characterized by a predetermined bandwidth;
- an image acquisition apparatus sensitive to said predetermined bandwidths for taking an image of each of said at least three phase-shifted projected patterns on the object; each of said images including a plurality of pixels having intensity values; and
- a controller configured for:
- a) receiving from the image acquisition apparatus said at least three images of the projected patterns onto the object;
- b) computing the object phase for each pixel using the at least three object intensity values for the corresponding pixel; and

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c) computing the relief of the object at each pixel position using said object phase at the corresponding pixel position; ~~The system as recited in claim 15,~~

wherein said pattern projecting assembly includes a grid illuminated by an illuminating assembly, a spectral splitter to be positioned between said grid and said illuminating assembly and a projector for projecting said illuminated grid onto said object; said illuminating assembly including a source of white light so positioned as to be projected through said grid.

17. (Currently Amended) A system for measuring the relief of an object, said system comprising:

a pattern projecting assembly for simultaneously projecting at least three phase-shifted patterns onto the object; each of said projected patterns being characterized by a predetermined bandwidth;

an image acquisition apparatus sensitive to said predetermined bandwidths for taking an image of each of said at least three phase-shifted projected patterns on the object; each of said images including a plurality of pixels having intensity values; and

a controller configured for:

a) receiving from the image acquisition apparatus said at least three images of the projected patterns onto the object;

b) computing the object phase for each pixel using the at least three object intensity values for the corresponding pixel; and

c) computing the relief of the object at each pixel position using said object phase at the corresponding pixel position; ~~The system as recited in claim 15,~~ wherein said pattern projection assembly includes at least two pattern projecting apparatuses and a reflecting

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arrangement; each of said pattern projecting apparatus being configured to project a light having a predetermined bandwidth through a pattern; said reflecting arrangement being so configured as to direct said projected patterns along a common direction of incidence.

18. (Currently Amended) The system as recited in claim 16 ~~15~~, wherein said image acquisition apparatus includes at least one camera sensitive to said predetermined bandwidths.

19. (Currently Amended) The system as recited in claim 16 ~~15~~, wherein said computer includes memory means for storing said images during their process.

20. (Currently Amended) The system as recited in claim 16 ~~15~~, wherein said computer includes at least one of a storing device, an input device and an output device.

21. (Currently Amended) The use of the system of claim 16 ~~15~~, for lead-coplanarity inspection.

22-23. (Cancelled)

24. (Previously Presented) A three-dimensional image grabber, comprising:

a means for simultaneously projecting at least two phase-shifted patterns onto the object; each of said projected patterns being produced by decomposition of one of: a white light and: a non-white light including a plurality of monochromatic lights, into one of: a plurality of monochromatic lights and: non overlapping bandwidths; and

a means for simultaneously taking an image of each of said projected patterns on the object; said image taking means being sensitive to one of: said plurality of monochromatic lights and: said non overlapping bandwidths.